

CAPPING CONCRETE TEST SPECIMENS FOP FOR AASHTO T 231



Note: It is advisable to case-harden the capping surface of steel plates to a Rockwell hardness of HRC 48 to help maintain the capping surface free of objectionable defects.

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Scope

This FOP covers the apparatus, materials, and procedure for capping hardened concrete specimens using either high-strength gypsum plaster or sulfur mortar.

Capping of freshly molded specimens is not covered. (Refer to AASHTO T 231 for a discussion of this procedure.)

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Significance

Procedures are described for preparing surfaces of hardened concrete cylinders, drilled cores, or beams in preparation for strength testing when the surfaces do not conform to the requirements of the applicable testing procedures.

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Apparatus

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- **Capping Plates:** Capable of providing surfaces plane to within 0.002 inches across any dimension.

Glass plates of at least 1/4" thickness or steel plates of at least 1/2" thickness shall be used for high-strength gypsum plaster capping.

Sulfur mortar capping plates shall be a machined metal plate of at least 1/2" thickness.

In all cases, plates shall be at least one inch larger than the specimen being prepared.

When new, metal plates shall be smooth and free of gouges, grooves, or indentations beyond those caused by the finishing operation. When in use, they shall be free of gouges, grooves, indentations, or other imperfections exceeding 0.010 in depth or 0.05 in² in surface area.

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- **Alignment Devices:** Guide bars or bulls-eye levels used to ensure that no cap departs from perpendicularity to the axis by more than 1/8" in 12 inches. When guide bars are used for cylinders, they must be positioned so that no cap is more than 1/16" off center.

Caution: Sulfur mortar reacts with organic compounds such as oil to release hydrogen sulfide gas. In high concentrations it is lethal. It is advisable that the melting pot and capping area be within a vent hood with fumes exhausted out of doors to prevent buildup of the gas.

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- **Melting Pot for Sulfur Mortar:** Melting pots equipped with peripheral heating suitable to prevent accidents when reheating cooled capping material (in lieu of peripheral heating elements, a steel rod may be used to transfer heat and provide a “halo” of melted material in the crust during reheating).

Melting pots should be thermostatically controlled to prevent sulfur fires. Pots should only be used under a vent hood exhausting the fumes out of doors.

- **Cube Molds:** Molds capable of forming cubes of 2-inch size (50mm molds are also permitted), consisting of two pieces and a base plate. Molds shall have a maximum of three compartments, meeting the requirements of Table 1.
- **Cover Plate (for cube molds):** Conforming to figure 1 of AASHTO T 231, providing a means of overfilling the molds when pouring sulfur mortar strength specimens.
- **Testing Machine:** Complying with AASHTO T 106 for testing compressive strength of capping materials.

Table 1 – Permissible Variations of Cube Molds

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Parameter	2-inch Cube Molds	
	New	In Use
Deviation from planeness of sides	< 0.001 inch	< 0.002 inch
Distance between opposite sides	2 inches \pm 0.005	2 inches \pm 0.02
Height of each compartment	2 inches + 0.01 to –0.005 inches	2 inches + 0.01 to –0.015 inches
Angle between adjacent faces	90 \pm 0.5°	90 \pm 0.5°

10

Capping Materials

- **For moist-cured specimens:** High-strength gypsum plaster or sulfur mortar.
- **For air-dried specimens or those requiring soaking prior to testing:** Sulfur mortar.
- **Strength requirements:** Both sulfur mortar and high-strength gypsum plaster may be used provided they meet the following strength requirements:

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| 11 | <ol style="list-style-type: none">1. Sulfur mortar must achieve 5000 psi strength after 2 hours of hardening.2. High-strength gypsum plaster must achieve 5000 psi strength when subjected to the same environment and time of hardening as sulfur mortar.

Further, the proportion of water used for mixing gypsum plaster capping material should be between 26 and 30 percent by mass of the high-strength gypsum cement.3. Strength of capping materials must be made for each lot of material and at intervals not exceeding three months.4. If a given lot fails the strength test, it shall not be used and replacement material must be obtained. The replacement material will be tested weekly until four consecutive tests indicate compliance with strength requirements. |
| 12 | <p>Determining compressive strength:</p> <ul style="list-style-type: none">• For high-strength gypsum plaster, mold specimens as required by AASHTO T 106. Conduct strength test as for sulfur mortar (see sulfur mortar, steps 7 through 9 below).• For sulfur mortar, mold cubes and conduct strength testing as follows:<ol style="list-style-type: none">1. Attach the cover plate to the top of a clean cube mold the surfaces of which have been lightly coated with mineral oil.2. Bring the assembled apparatus to a temperature of 68 to 86° F, lightly coat surfaces that will be in contact with the sulfur mortar with mineral oil. Place assembled apparatus near the capping area. |
| 13 | <ol style="list-style-type: none">3. Bring the temperature of the molten sulfur mortar in the pot to a range of 265 to 290° F, stir thoroughly, and begin casting cubes.4. Using a ladle, pour the molten sulfur mortar into the filling holes of the cover plate until level with the top of the filling holes.5. Allow the material to cool such that maximum shrinkage occurs (usually about 15 minutes), |

then refill with molten sulfur mortar to the top of the filling holes.

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6. After cubes have solidified, remove mold without breaking off knobs formed by filling holes and remove oil, sharp edges, and fins.
7. After a two-hour period at room temperature, check planeness of bearing surfaces, measure dimensions, and calculate cross-sectional area.
8. Test for compressive strength according to AASHTO T 106, applying the test load at a rate of 200 to 400 pounds/second.
9. Calculate compressive strength by dividing the total load by the cross-sectional area.

15

Capping Procedure – General

- During each day's capping operation check planeness of the caps at least three times, at the beginning, middle, and end of the run.
- Caps are checked using a straightedge and a feeler gauge across at least 3 diameters/dimensions to ensure that caps do not depart from a plane by more than 0.002 inches.
- Caps should be about 1/8" thick but in no case may any portion of a cap exceed 5/16" in thickness.
- If specimens have any material adhering to them that would interfere with bonding to the cap, this material should be removed prior to capping. Light scoring of smooth surfaces is permissible to improve bond with the capping material.
- A thin coating of mineral oil or grease may be used on capping plates to prevent bonding of the capping material to these surfaces. In no case may the specimen surfaces be oiled.



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Capping Procedure

- **High-Strength Gypsum Plaster:**
 1. Mix the material at the same percent of

mixing water as used for qualification testing.

2. Rapidly spread the capping material on the capping plate.
3. Immediately place the specimen on the capping material, using guide plates or a bulls-eye level to assure perpendicularity of the axis to the capped surface.
4. Allow material to harden sufficiently to avoid damage during removal from the capping plate.
5. Material must harden for at least two hours prior to testing of the specimen.

• **Sulfur Mortar:**

1. Empty the pot and refill with fresh material with sufficient frequency to assure that material is not being used more than five times. Capping material must be kept dry to prevent foaming.
2. Preheat sulfur mortar to about 265° F.
3. Warm the capping plate to slow hardening, thus permitting production of thin caps.
4. Oil capping plate lightly and stir capping compound prior to pouring each cap.
5. Dry off surfaces of specimens to prevent foaming and inclusion of air bubbles between the specimen and capping compound.
6. Pour capping material into mold and immediately place specimen in compound, using guide rods or bulls-eye level to assure perpendicularity of the axis to the capped surface.
7. Allow sufficient time for cap to harden prior to removal from mold.
8. At least two hours of hardening must be allowed prior to testing of specimen.



Protection of Specimens After Capping

- Moist cured specimens must be maintained in a moist surface condition between the capping and testing by returning them to moist storage or wrapping with at least two layers of wet burlap.
- Specimens with gypsum plaster caps should not be stored in moist rooms longer than four hours after capping and capped surfaces must be protected from water dripping on them.

Tips!

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- Check capping plate condition frequently for planeness and surface defects.
- Check strength of capping material at required intervals. 5000 psi is required.
- Check capped surfaces for conformance with planeness requirements.
- Use guide bars or bulls-eye level to assure conformance with perpendicularity requirements (1/8" in 12").
- Make sure that sulfur mortar is dry to prevent foaming.
- When using sulfur mortar, dry the surfaces of specimens to prevent inclusion of gas bubbles in the caps.

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- Use the same water percentage to mix high-strength gypsum plaster as for qualification tests.
- Take precautions to prevent buildup of hydrogen sulfide gas in lab facility by having capping pot and capping area under a vent hood that exhausts gas out of doors.

REVIEW QUESTIONS

1. Describe the requirements for capping plates.
2. Describe the requirements for high-strength gypsum capping material.
3. Describe how caps are checked for dimensional tolerances.
4. Describe the process for conducting strength tests of sulfur mortar for compliance testing.
5. Describe the capping process using high-strength gypsum plaster.
6. Describe the capping process using sulfur mortar.
7. Discuss safety precautions for using sulfur mortar.

